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GUIDELINES FOR CLEANING AND STERILIZING DAIRY EQUIPMENT

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GUIDELINES FOR CLEANING AND STERILIZING DAIRY EQUIPMENT

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Indian Standard

GUIDELINES FOR CLEANING AND STERILIZING DAIRY EQUIPMENT

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 7 October 1969, after the draft finalized by the Dairy Equipment Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 All dairy equipment should be properly cleaned and sterilized as milk provides an excellent medium for the growth of micro-organisms. At the same time detergents and sanitizers used for cleaning and sterilization should be so selected as not to affect the material of the equipment. This standard provides guidelines for such selection. It also includes information (*see* Appendix A) on the types of soils, general requirements of detergents and sanitizers, their storage, and precautions necessary for their use. Cleaning of the dairy floors and walls has also been covered. The code also prescribes limits of residual micro-organisms for various equipment so as to help in checking proper cleaning and sterilization.

0.3 In the formulation of this standard considerable assistance has been derived from B. S. 2756 : 1956 'Recommendations for the use of detergents in the dairying industry' issued by British Standards Institution. Full use has also been made of the information received from the National Dairy Research Institute, Karnal.

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1. SCOPE

1.1 This standard recommends the choice of detergents and sterilizers, cleaning and sterilizing procedures, and tests for checking for the cleaning of dairy equipment, dairy floors and dairy walls. These recommendations are applicable at all levels of milk handling and processing, namely, village level, fluid milk handling plant, and special dairy equipment in milk products manufacturing establishments.

2. GENERAL

2.1 Before selecting the particular detergent, consideration should be given to the type of soil, the quality of water supply, the materials of the surface

to be cleaned, the washing equipment, and the method of cleaning, namely, whether it be by soaking, brushing, and spraying and recirculation or by both. The water generally available is hard and should be treated to make it soft to maximize the efficiency of detergents. The availability and cost should also be examined during the choice of detergents/sanitizers.

2.2 The usual procedure for cleaning and sterilization/sanitization of major dairy equipment should consist of:

a) draining to remove any residual loose milk and other matter;

b) pre-rinsing, with cold or tepid water to remove as much of milk residue and other matter as possible;

c) warm to hot detergent washing to remove remaining milk solids;

d) hot water rinsing to remove traces of detergents;

e) sterilization/sanitization to destroy all pathogens and most of the non-pathogens, usually also done just before the use of equipment; and

f) draining and drying to help prevent bacterial growth and corrosion.

2.3 Cleaning and sterilization/sanitization of dairy equipment may be broadly classified into:

a) hand cleaning and sanitization,

b) mechanical cleaning and sanitization, and

c) in-place cleaning and sanitization.

2.3.1 Hand cleaning and sanitization will apply to small equipment. It should be generally adopted in small dairies or milk collection/chilling centres, where it is uneconomical to have costly machine-cleaning. The temperature of detergent solution in hand cleaning should be such that it does not affect the hands. A bucket of cleaning solution and a hand brush besides some warm water should serve the purpose of cleaning. Sanitization should be effected with the help of steam jet, or steam chest, or chlorine solution.

2.3.2 Mechanical cleaning should be generally adopted for milk cans and milk bottles in milk plants.

2.3.3 In-place cleaning is increasingly used because of its several advantages. Besides being labour-saving and preventing damage to equipment (due to daily dismantling and assembling), this method of cleaning ensures that all equipment receives uniform treatment day after day. In-place cleaning should not be adopted for all equipment, its success depends upon several factors, such as proper lay-out and installation, proper temperature, adequate velocity of the detergent solution, use of detergents designed specifically for recirculation cleaning and sufficient cleaning time.

3. VILLAGE LEVEL

3.1 Choice of detergent/sanitizer

3.1.1 The detergent mixtures suitable for use in villages are given in Table 1.

TABLE 1 DETERGENT MIXTURES FOR USE AT VILLAGE LEVEL

Sl No.	Ingredients	Quantity per 1 000 g	Remarks
(1)	(2)	(3)	(4)
i)	Washing soda (commercial hydrated sodium carbonate)	850 g	For general use
	Tri-sodium phosphate	100 g	
	Sodium metasilicate	50 g	
ii)	Washing soda (commercial hydrated sodium carbonate)	850 g	For general use excluding aluminium utensils
	Sodium sulphite	50 g	
	Tri-sodium phosphate	150 g	

NOTE — For every 1 000 g of the detergent mixtures specified in this table, 10 g of a wetting agent, for example, Acinol-N, Idet-10, Teepol, or equivalent compound, should be added. [Wetting agents comprise sodium alkyl/aryl sulphonates (anionic).]

3.1.2 The sanitizer may be either scalding water (90° to 95°C) or chlorine solution (200 ppm available chlorine).

3.2 Procedure

3.2.1 Cleaning of utensils should be done as follows:

a) Mix the ingredients in proportion mentioned and add sufficient water to make a paste. About 15 g of the mixture will be required for cleaning a utensil of 10-litre capacity.

b) Rinse the utensil with cold water (tepid water in cold season) and drain out the rinsings.

c) Scrub the utensil (inside and out) with the above detergent paste using a clean brush or coir to loosen and remove all milk residues.

d) Wash the utensil again with enough cold water (tepid water in cold season) to remove traces of detergent, and allow them to drain and dry.

3.2.2 The cleaned utensils may be sanitized by rinsing with either scalding water, or chlorine solution, just prior to use.

4. MILK HANDLING AND PROCESSING EQUIPMENT (IN A FLUID MILK HANDLING PLANT)

4.1 Choice of Detergent/Sanitizer

4.1.1 The general purpose detergent mixtures for use in dairies are given in Table 2.

TABLE 2 GENERAL PURPOSE DETERGENT MIXTURE FOR USE IN DAIRIES

Sl No.	Ingredients	Quantity per 1 000 g	Remarks
(1)	(2)	(3)	(4)
i)	Tri-sodium phosphate Wetting agent*	850 g 150 g	For general use
ii)	Tri-sodium phosphate Sodium metasilicate Wetting agent*	650 g 200 g 150 g	For aluminium utensils for general use
iii)	Tri-sodium phosphate Sodium sulphite Wetting agent*	750 g 100 g 150 g	For tinned utensils

*Wetting agent like Acinol-N, Idet-10, Teepol, or equivalent compound, may be used.

NOTE 1 — Tri-sodium phosphate is recognized to have better detergent properties compared to washing soda. Wherever it is not available it may be replaced partly or fully by washing soda.

NOTE 2 — It is preferable to add 200 g of sodium hexametaphosphate per kilogram of the mixtures specified in this table, where water is not otherwise softened.

4.1.2 The sanitizer may be steam or scalding water (90° to 95°C) or chlorine solution (150 to 200 ppm available chlorine).

4.2 General Procedure for Handwashing

4.2.0 Wherever handwashing is involved, it is recommended that the hands and eyes of the operator be adequately protected by the use of gloves, goggles, etc.

4.2.1 The normal cleaning and sanitization of handwashed dairy equipment should be done as follows:

a) Prepare 0·8 to 1·0 percent solution of the detergent mixture (any set in Table 2) in water, so as to give a minimum caustic alkalinity of 0·5 percent (*p*H over 11·0) in a wash-up tank and maintain the temperature at about 50°C.

b) Thoroughly rinse the utensils with clean cold water (tepid water in cold season).

c) Introduce the detergent solution into the equipment (quantity of solution to be determined by requirement and experience). Brush the equipment surface (inside and out) thoroughly with a clean brush.

d) Wash the utensil with enough of fresh cold water (tepid water in cold season), using clean brush again if needed to remove all traces of detergent.

e) Allow the equipment to drain thoroughly for drying (1 to 2 h).

f) Sanitize the equipment surface by steam or hot water soon after cleaning; or by rinsing with chlorine solution (200 ppm available chlorine) just before using.

4.2.2 The equipment normally handwashed include the following:

a) Milk cans;

b) Weighing bowls/pans and receiving tanks/vats;

c) Milk pumps;

d) Pipe lines;

e) Storage, holding and transport tanks;

f) Batch-type holding pasteurizers;

g) Bottle filling machines;

h) Surface coolers;

j) Plate type heat exchangers;

k) Milk bottles;

m) Milk crates; and

n) Cotton filter cloths.

4.2.3 Some salient points in the cleaning and sanitization of the equipment mentioned in **4.2.2** are given in Table 3.

5. SPECIAL DAIRY EQUIPMENT

5.1 Rail/Road Milk Tanks — Daily cleaning of the milk tanks/tankers should be carried out in the following manner:

a) Wash with a hot detergent solution having 3 percent sodium hydroxide at 60° to 70°C.

NOTE — In the case of aluminium tankers, the detergent solution should compose of a mixture of sodium metasilicate and sodium hydroxide to have alkalinity of about 0·5 percent as sodium hydroxide.

b) Follow by a washing with enough hot water at 85°C.

NOTE — The washing is conveniently carried out by using detergent tanks having a capacity to hold 2 000 to 2 500 litres of detergents.

c) Before filling, the tank/tanker should be sanitized by circulating chlorine solution (50 to 100 ppm) and drained off completely.

TABLE 3 SALIENT POINTS FOR CLEANING OF SOME HANDWASHED EQUIPMENT

(*Clause* 4.2.3)

Sl No.	Name of the Equipment	Salient Points
(1)	(2)	(3)
i)	Milk cans	Can and lid should be treated in the same way for cleaning. Milk cans should be cleaned within 30 minutes of emptying in hot season before milk film dries up. Hand-operated steam jet is desirable for sterilization. When the cans are machine-washed, they should be cleaned from outside using the same sequence of detergents at least once in a week to ensure maintenance of attractive appearance.
ii)	Weighing bowls/pans and receiving tanks/vats	The covers, strainers, outlet valves and fittings should be dismantled and manually cleaned daily.
iii)	Milk pumps	Should be dismantled for cleaning and then reassembled for sterilization.
iv)	Pipe lines	Normally cleaned-in-place, but should be dismantled at intervals of once in a month for inspection and thorough cleaning. A long enough tank/trough is needed to completely submerge the pipes in the detergent solution. Pipes should be brushed internally with a long-handled brush. Washed pipes should be placed on clean rack (preferably mounted on wheels. The pipes are best sterilized after assembling with steam or scalding water.
v)	Storage/holding/transport tanks (*see also* **5.1**)	Normally cleaned-in-place. If necessary, operator should enter large tanks for proper cleaning. Then he should wear clean rubber boots and goggles and use clean long-handled brush. For sterilization, clean live-steam hose pipe should be introduced into the tank (after closing all other openings). Steaming should be done till all parts of the tank are scalding hot.
vi)	Batch-type holding pasteurizers	Long-handled brush should be used. Sterilization with live steam as in the case of tanks is the best.

(*Continued*)

TABLE 3 SALIENT POINTS FOR CLEANING OF SOME HANDWASHED EQUIPMENT — *Contd*

Sl No.	Name of the Equipment	Salient Points
(1)	(2)	(3)
vii)	Bottle filling machines	All valves, air pipes and other removable fittings should be dismantled and washed and sterilized separately. After re-assembling the plant, it should be sterilized again before use, this time preferably with chlorine.
viii)	Surface coolers	The surfaces should be scrubbed with a brush, while water/detergent solution is flowing down. Chlorine sterilization is the best.
ix)	Plate-type heat exchangers	Normally cleaned-in-place. The exchanger should be slackened until it begins to leak slightly during circulation of hot liquids. At regular intervals (determined by requirement and experience), the exchanger should be completely opened up and individual plates thoroughly scrubbed clean with brush. Scalding water sterilization is the best.
x)	Milk bottles	Brushing with the help of small-scale power-driven brushes is advantageous. All brushes should be thoroughly cleaned and sterilized daily after use. Chlorine sterilization of bottles is the best.
xi)	Milk crates	Washing by thorough scrubbing with warm detergent solution and hot water; final rinse should be satisfactory
xii)	Cotton filter cloths	Dirty filter cloths should be placed on a clean surface, hosed hard to wash off the dirt, then brushed with a soft brush. The cloths should then be boiled in a weak detergent solution. Detergent should be completely removed from cloths by couple of rinses in warm water, followed by couple of rinses in cold water. The cloths should be carefully squeezed and spread out to dry. The cloths should then be sterilized by boiling in fresh water.

5.2 HTST Plate-Type Pasteurizer — normally cleaned-in-place. The cleaning of heat exchangers should be carried out in accordance with the manufacturer's instructions. Typical instructions for the daily cleaning of heat exchangers are given in **5.2.1** and for periodic cleaning of heat exchangers are given in **5.2.2**.

5.2.1 *Daily Cleaning* — Daily cleaning of heat exchangers should be carried out in the following manner:

a) At the close of the milk run and after all services have been shut down, cold water should be run through the tip tank and pumped through the heat exchanger to flush out the remaining milk.

b) To avoid unnecessary pressure on the plate rubbers due to expansion during the circulation of hot liquids, the heat exchanger should be slackened until it begins to leak slightly.

c) In the case of stainless steel brine sections, the brine side of the plates should be flushed out with cold water which should be admitted at the bottom of the section.

d) A solution of the acid detergent (0·1 percent nitric acid or 0·5 percent phosphoric acid) should be circulated within a closed circuit at a temperature of 65°C for 20 minutes at a rate of flow not less than 10 percent more than the milk flow.

e) The acid cleaning is followed by a solution of the detergent (caustic soda + trisodium phosphate and wetting agent having alkalinity of not less than 0·5 percent, and not more than 1·0 percent, as sodium hydroxide. Alkalinity higher than 0·5 percent should be maintained when the length of run is more). This solution should be circulated within a closed circuit at a temperature of 70°C for 20 minutes at a rate of flow not less than 10 percent more than the milk flow.

f) The tightness should then be checked and the heat exchanger slackened still further, if necessary, until a slight leakage of detergent occurs.

g) The detergent solution should be ejected from the heat exchanger by pumping cold water through. The detergent solution should be allowed to cool to 38°C before ejection.

h) When the heat exchanger has been cooled to 38°C, it should be opened up, the plates brushed down and finally hosed with clean, cold water ready for reassembly and sterilization.

5.2.1.1 Materials for cleaning heat exchangers are available by means of which the plates may be cleaned and maintained bright and scale-free with virtually no brushing. These methods rely on the circulation of nearly neutral and alkaline solutions only, involving the use of polyphosphates.

5.2.1.2 The methods depend to a certain extent on a good rate of detergent circulation. Although it may not be necessary to brush the plates after circulation of the detergent, yet it is essential that attention should be paid to parts of the plant which are not subjected to the full flow of the detergent. This should particulary apply to thermometer pockets and pressure gauge fittings, which should be thoroughly brushed after detergent circulation.

It is recommended that these special methods of cleaning should not be attempted without prior reference to the plant manufacturer.

5.2.2 *Periodic Descaling* — When the heat exchanger is being used for heating milk above 38°C, it may occasionally be necessary to circulate descaling solution to remove milk-stone that may have accumulated. Dilute solutions of phosphoric or nitric acid free from harmful impurities may be used for this purpose, but the plant manufacturer should be consulted or a special cleaner recommended by the manufacturer should be used. Such periodic descaling with acid should be carried out as follows:

a) An alkaline detergent solution should first be circulated according to the instructions given in **5.2.2**, after which all traces of the solution should be flushed from the plant with cold water.

b) The descaling solution at the recommended concentration and temperature should be circulated.

c) The descaling solution should then be ejected from the plant by flushing through with cold water.

d) When the plant has cooled below 38°C, it should be opened up and the plates brushed down with a weak solution of an alkaline detergent and finally hosed down with cold water.

NOTE — The strengths of the detergent solutions used for descaling are generally recommended to be double the strength of the detergent solutions used for daily cleaning.

5.2.2.1 The following precautions should be taken in the use of an acid descaling solution:

a) When the milk contact surfaces of the plant are not all of stainless steel, means should be provided to exclude these surfaces from the system while the descaling solution is being circulated, unless it has been ascertained that the solution will not affect these surfaces.

b) It is important that the circulation of acid should always be preceded by the normal alkali circulation. Circulation of acid before alkalli may lead to serious corrosive damage to the stainless steel plates of a heat exchanger due to the acid reacting with the chlorides in the milk deposits on the plates and forming hydrochloric acid. The danger is that this acid may not be removed from the stainless steel surface and diluted in the circulating cleaner as fast as it is formed, with the result that hot hydrochloric acid, which is very corrosive to stainless steel, may momentarily remain in contact with the plate surfaces. This is especially so if the rate of circulation is allowed to fall.

c) During the circulation of detergents, it is important to ensure that the inlet of the circulating pump is fully covered with liquid to avoid air being drawn into the pump.

5.3 Can Washer — Mechanical washers, automatically or manually operated, are constructed on either the rotary or straight-through principles.

5.3.1 The following stages of treatment may be provided, and the treatment should include both can and lid:

a) Drainage stage for liquid milk residues:

b) Pump-fed pre-rinsing with cold or warm water;

c) Drainage stage or stages;

d) Pump-fed jetting with detergent at not less than 70°C;

e) Drainage stage or stages;

f) Rinsing stage, pump fed or by steam and water ejector at not less than 88°C;

g) Final fresh water rinsing with steam and water ejector at 88° to 93°C.

h) Live-steam injection; and

j) Hot-air drying at 95° to 115°C.

5.3.1.1 Although with freshly emptied cans used for farm collection work it is possible, with careful operation of the machine, to obtain good washing results by means of very hot water alone in the fourth stage, it should be the normal practice and generally it is desirable that in this, the first washing stage, a detergent solution should be used. The detergent should be suitable for use with tinned steel, and a concentration of between 0·5 and 1·0 percent (as caustic alkalinity) is desirable. The concentration should be regularly checked and maintained during the period of operation of the machine.

5.3.1.2 Soft water should preferably be used to supply to a can-washing machine. When the use of hard water is unavoidable, scale in the tanks and jetting system may be minimized by the addition of a sequestering agent [for example, sodium hexametaphosphate or ethylenediamine tetra acetic acid (EDTA)] to the water supply or the detergent solution. Tanks should be emptied and thoroughly rinsed each day after use.

5.4 Bottle Washer

5.4.1 *Soaker-Hydro Machines* — The sequence of treatment in machines of this type varies widely. The treatment may, however, be summarized as follows:

a) Pre-rinsing by jetting or soaking in water at a temperature between 35° and 40°C;

b) Soaking with or without jetting in detergent solution at 60° to 63°C;

c) Rinsing by jetting and sometimes soaking with warm water; and

d) Final jetting with mains water.

5.4.1.1 Strongly alkaline detergents should be used, and the temperature should reach at least 60°C. Concentrations of detergent solution vary from 1 to 3 percent; usually an alkalinity of 1 percent as sodium hydroxide is regarded as a minimum. Where the main detergency effort is in soaking, concentrations higher than those in jetting or hydro machines should be used. Surface-active agents may often be used for those machines, but their concentration depends upon the extent of the detergent jetting which accompanies the soak and, also, the pressure at which the solution is circulated through the jets. Where jetting is used, an excessive content of surface-active agents in the solution will cause foaming in the detergent tank and consequent loss of detergent solution through the tank overflow.

5.4.2 *Hydro Machine*—The sequence of treatment may be as follows:

a) Pre-rinsing with water at a temperature between 35°C and 40°C;

b) Jetting with detergent solution at 60° to 65°C;

c) Rinsing with warm water; and

d) Final rinsing with cold water. (Hot water is generally used when washing bottles for sterilized milk.)

5.4.2.1 In this type of machine the pre-rinse should be usually fed from the warm rinse tank except in certain machines where no warm rinse tank is incorporated. The final mains water rinse should continuously run into the warm rinse tank, while the excess volume is pumped away to the pre-rinse. The detergent tank should remain isolated from this sequence, and losses in strength may be due to interaction with milk residues and milk acids, dilution by water brought forward by the bottles from the pre-rinse and carry-over by the bottles from the detergent section into the warm rinse. Strongly caustic alkalis should be used. Mixtures of sodium hydroxide, sodium silicate, sodium phosphates and sodium poly-metaphosphates are commonly used for this purpose. Different types of machines often need a different balance of detergent constituents in order to provide satisfactory cleaning, sterilization and lubrication. Detergent concentrations should usually be of the order of 2 to 3 percent. Where sterilization depends solely on the alkalinity of the detergent solution, an alkalinity equivalent to not less than 2·5 percent sodium hydroxide at a temperature of not less than 60°C is recommended. If for any reason, it is not possible

to maintain a temperature less than 60°C, the caustic alkalinity should be correspondingly increased. A pump pressure of between 1·05 and 1·40 kg/cm² is usually most satisfactory for the detergent section, although limitations may be imposed by the type of jet.

5.4.3 *General Observations*

5.4.3.1 The efficiency of all automatic bottle-washing machines depends on correct mechanical maintenance to ensure that each bottle receives its full quota of treatment on: (a) adequate pre-rinsing to prevent fouling of the detergent solution by milk residues, (b) maintaining the detergent solution at the correct temperature and concentration, and (c) preventing recontamination of the bottles from the rinses which follow the detergent treatment.

5.4.3.2 Detergent solutions in all bottle-washing machines should be completely changed at regular intervals, usually once a week. This is particularly important during the summer months. It is recommended also that, when the solution is changed, all tanks should be thoroughly cleaned and under daily observation to ensure operation at maximum efficiency.

5.4.3.3 In addition to cleaning the bottles, the detergent solution should be relied upon to sterilize them. Temperature and concentration and period of contact are the factors in the killing power of the detergent solution. The period of contact should generally be fixed by the type of machine and accordingly only the temperature and concentration are within the control of the operator. The temperature of the detergent solution should be held as high as possible, bearing in mind the risk of damage to the bottle. Regular titration or automatic metering to gauge the concentration is essential, refresher charges of the detergent being added as required. For routine testing, testing equipment, which may be supplied by the detergent manufacturer, could be used.

5.4.3.4 Bottles should be filled with milk and capped as soon as practicable after cleaning and sterilization.

5.4.3.5 Although the bottles should be in a bacteriologically satisfactory condition when they leave the detergent section, subsequent contamination often takes place in the rinsing sections, particularly those sections which utilize re-circulated water and normally operate at a temperature between 32°C and 45°C. The warm rinse should be renewed every day with fresh water, and kept as clean as possible; the water in it should be dosed with 60 ppm of available chlorine from a solution of an approved sodium hypochlorite, and this concentration maintained. It is recommended that the rinsing section be cleaned and sterilized regularly, daily if possible.

5.4.3.6 Water samples should be taken occasionally from final mains rinse jets, as these frequently develop high populations of micro-organisms which may recontaminate the finished bottle. Where final rinse jets are found to be infected, they should be taken down and thoroughly boiled out with a general-purpose detergent before being replaced.

5.4.3.7 The bacteriological state of the whole bottle-washing process should be constantly checked. To this end washed bottles and samples of water from the warm rinse and cold mains rinse sections should be regularly re-examined bacteriologically. Samples of the mains water at the point of entry to the machine should similarly be examined. The bacteriological condition of water softeners of the ion-exchange type should be checked periodically and they should be sterilized, if necessary, according to the manufacturer's instructions.

5.4.3.8 In fully automatic machines it is desirable that the detergent solutions used should have adequate lubricating properties, and further, that it should not contain an excess of certain materials which may themselves be the cause, either directly or indirectly, of considerable mechanical friction. This may be caused by the use of the detergent mixture of too great a proportion of silicates or polyphosphates, or too low a caustic alkalinity, and/or by the too liberal use of surface-active agents which may result in the rollers and pins of the main chains and other bearings in the machine becoming completely drained of their lubricating coat of detergent. Such an undesirable condition is likely to be more noticeable in soaking type machines where links, pins and bearings are actually immersed in the solution.

5.4.3.9 The use of unsuitable detergents will cause undue mechanical friction and possibly overloading where the machine is of a soaker or sprayer type and, irrespective of the type of drive whether it be mechanical or hydraulic. It is, however, more readily seen on machines incorporating hydraulic drive.

5.5 Homogenizers — The homogenizer is a particularly difficult piece of equipment to wash and sterilize adequately. The piston rods of such machines are generally provided with a type of packing gland which it is not possible to remove daily for cleaning purposes, and this part of the equipment may, therefore, be a source of trouble. The following cleaning procedure is recommended, it being assumed that the inlet side of the machine is connected to a hopper of feed tank which is normally used to provide an adequate head of milk to the machine:

a) The control valve should be adjusted to give reduced pressure.

b) The feed tank should be filled or partly filled with warm water and all milk residues flushed out. This would involve starting up the machine.

c) The above procedure should be repeated with a solution of a general purpose detergent (of caustic alkalinity 0·5 percent containing no undissolved material at a temperature of 60° to 65°C).

d) The homogenizer should be flushed through with warm fresh water.

e) The inlet and outlet manifolds should be dismantled and the suction valves and pressure control valve removed. These parts should be washed and scrubbed in a solution of a general-purpose detergent, rinsed and reassembled for sterilization. Sterilization is effected by circulation of chlorine solution (150 to 200 ppm) at 60° to 70°C for 15 minutes.

5.5.1 The following precautions should be taken in cleaning the homozenizer:

a) Before commencing the operation specified in **5.5**, the locking rings of each piston packing gland should be loosened to allow as much leakage as possible without actually blowing out or damaging the packing. The glands should be kept loose throughout all the subsequent operations.

b) When using fresh water alone, the machine should be run for as little time as is necessary to carry out each operation, because of the absence of adequate lubrication of the piston rods and bores. When using an alkali-based detergent the machine may be run without fear of damage occurring due to this factor.

c) Whenever acid cleaning is required to be done, circulate dilute acid (0·3 percent nitric acid or 0·5 percent phosphoric acid) at 60° to 65°C for 5 to 10 minutes through the homogenizer, followed by alkali circulation.

5.6 Cream Separator — The following procedure should be adopted:

a) Flush out thoroughly with clean cold water (tepid water in cold season) while the separator is still running.

b) Dismantle the separator completely.

c) Wash each part by thorough scrubbing with a clean brush using hot detergent solution.

d) Rinse well each part with hot water to remove trace of detergent.

e) Arrange neatly on a clean rack for drying.

f) Re-assemble and sterilize with scalding water or chlorine solution before use.

5.7 Cleaning and Sterilization of Ice-Cream Freezer — The cleaning and sterilization of freezers pose certain special problems not encountered in other items of equipment and as far as possible the instructions furnished by the manufacturer with each freezing machine shall be followed. However, the general procedure that is normally adopted for cleaning horizontal batch freezers is given below:

a) At the end of the day's operations, the main refrigeration and thermostat controls should be turned off. The freezer should be warmed up gradually to prevent any strain on the machine and in no case shall hot water be used initially. Fill the freezer (one-half to two-thirds full) with cold water, allow the blades to rotate a few turns and drain out the rinse water. This should be repeated several times using increasingly warm water up to a temperature of about 60°C until the hopper and freezer have been rinsed free from the mix and tampered.

b) Fill the hopper with the hot detergent solution (60° to 65°C). Wash the exterior of the freezer, the hopper valves and strainers, using a stiff brush. Run the washing solution into the freezer drum (two-thirds full) with cold water, allow the blades to rotate a few turns. Remove the head and dasher assembly from the freezer carefully and brush them thoroughly with the detergent solution in a sink or in the wash-up tank. The freezer door should also be removed and washed similarly. Examine the inside of the freezer to ensure that it is free from pieces of fruits, nuts, etc.

c) Re-assemble the freezer and rinse with water at 60° to 65°C to remove the detergent.

d) For sterilization, fill the hopper with hot water (85°C) so that the screen is immersed and allow it to stand for 2 minutes. Drain the water into the freezer and add more hot water so that the freezer is two-thirds full, turning the dasher 3 to 4 times and then drain out the water. If more stringent treatment is required, steam may be blown into the freezer for 5 minutes (with the gate partially open) so that the condensate that drips from the gate is at 85°C. The freezer should then be allowed to stand with the gate open for drying until ready for use. Alternatively, the washed freezer may be sterilized by filling the hopper and chamber with chlorine solution (200 ppm), agitating for one to two minutes and then draining out. Immediately after this treatment the chamber should be rinsed with chlorine water (5 to 10 ppm). It is desirable to re-sterilize the freezer by running chlorine solution (200 ppm) and then rinsing with chlorine water (5 to 10 ppm) if the machine is to be used the next day.

5.8 Butter Churns (Wooden and Metal)

5.8.1 *Wooden Churns* — The following procedure should be adopted:

a) Using a sharp butter trowel, remove butter adhering to the wood of the churn (and the worker).

NOTE — The practice of steaming the churn to remove adhering butter should be avoided, since it allows the fat to penetrate into the wood and make the churn more difficult to clean.

b) Partially fill the churn with water at about 80°C. If considered necessary, add a small quantity of a suitable wetting agent. Rotate the churn (with the worker) for 3 to 5 minutes. Drain off this water as rapidly as possible, and flush out any remaining fat from the bottom of the churn (and worker) by rinsing with hot water.

c) Fill the churn to one-fourth capacity with 0·5 percent general-purpose alkaline detergent solution at 80°C. Close the churn door. Remove sight glass. (This is necessary to avoid development of pressure when the churn is rotated, with possible cracking of the sight glass.) Rotate the churn for 5 to 10 minutes, first slow then fast. Stop the churn and drain as quickly as possible, again flushing the residue from the bottom of the churn with hot water.

d) Fill the churn to one-fourth capacity with hot water at 95°C. Rotate the churn for 15 to 20 minutes, first slow then fast. Drain off the water as rapidly as possible.

e) Open the churn door, as soon as water has drained off. Position the churn with open drain cocks at top. This will induce a draught which will carry off the steam and dry the surface of wood. (Cover door opening with a wire mesh screen to prevent possible entrance of birds and rodents.)

f) Use clean long handled brushes, preferably of nylon and of various shapes and sizes, to clean the interior surfaces, opening, etc.

g) Chemical sanitization of the churn, if needed, is best done before the churn is used. Add chill water and then chlorine solution to give 50 to 200 ppm available chorine in water. Rotate the churn for 15 to 20 minutes. Before adding cream to churn, drain off the chlorine solution.

5.8.2 *Metal Churns* — The procedure for wooden churns may be adopted. In addition steaming may be employed as the first treatment.

5.8.3 *'Idle' Churns* — Wooden churns left unused for long time should be treated with hot lime water at intervals during the idle period. The churn

at each treatment should be washed with the hottest water available, and then be dried out. Metal churns do not require treatment during the idle period.

NOTE — Lime water may be prepared as follows:

Place half a sack of burnt lime in a barrel or drum, and fill with water daily, with stirring. Allow to settle. This provides a saturated solution of lime. The lime water is of sufficient strength when 35 ml will neutralize 9 ml of a 0·1 N sulphuric acid. Replenish the container with fresh lime as is required to maintain the strength of the lime water.

5.9 Steam-Jacketed Ghee Pans

5.9.1 *Ghee Pans of Stainless steel* — Usually cleaned by using both alkali and acid detergents. The frequency of cleaning depends upon the amount of 'soil' formation. Usually after every two batches, fill the pan about two-thirds with water and boil for 10 to 15 minutes. Hand-clean the inside surface with a clean, long-handled brush. Drain out completely. Fill the pan about one-half with 0·5 percent acid detergent solution, preferably phosphoric acid. If nitric acid is used on stainless steel surface, the strength should not be more than 0·1 percent and boil it for 10 to 15 minutes. Again hand-clean the inside and outside surfaces thoroughly with a clean, long-handled brush. Drain out completely. Fill the pan again about one-half with 0·5 percent alkaline detergent solution and repeat the cleaning procedure as for acid cleaning. A small amount of surface active agent (wetting agent) may be added to help the cleaning. Finally hose out inside and outside surfaces of pan thoroughly with tap water and drain.

5.9.2 *Ghee Pans of Aluminium* — Usually cleaned by using only acid detergents together with a small amount of surface active agent. The process is similar to the one described in **5.9.1**.

5.10 Evaporators and Vacuum Pans

5.10.1 Usually cleaned by circulating both alkali and acid detergents. Flush the pan with warm water (45°C) till the outlet water is clear. Two types of detergents/cleaners are recommended: (a) Alkaline cleaner to dissolve protein and saponify fat, and (b) acid cleaner to eliminate films of water hardness. Make alkaline solution in the forewarmer of 0·5 percent with alkaline detergents, preheat to 75° to 80°C, draw into the pan and boil under vacuum of 305 to 355 mm Hg. Boil for 30 minutes, the rate of intake should be adjusted to the rate of evaporation; drain and rinse with warm water. Follow the procedure with 0·5 percent acid detergent solution. Drain the rinse. Sterilize with steam for about 30 minutes. Remove manhole cover or sight glass and bottom outlet for air circulation for drying.

For very heavy milkstone deposits, first circulate hot (50° to 60°C) dilute phosphoric acid as 1 percent solution with 400 ppm wetting agents. Boil for half an hour as above, drain, rinse and then circulate alkali as above followed by acid detergent circulation and lastly by hot (50° to 60°C) water rinse. Drain and dry.

5.11 Roller Drier

5.11.1 After milk is finished, shut off the steam and flush the rollers while rotating with plenty of warm (45°C) water till all milk particles are removed from the roller, followed by hand-cleaning with a clean brush and detergent solution of 1 percent strength. Flush the rollers once again. Stop the rollers. Then remove the scrapper blades, soak them in the detergent solution and scrub them thoroughly with a clean brush followed by rinsing with warm water. Allow them to dry. The connecting milk pipe lines can be cleaned in the normal way by in-place cleaning method or by dismantling and hand-cleaning.

5.12 Spray drier

5.12.1 As soon as milk drying is over, the spray drier should be stopped and the chamber door opened, and with a long-handled clean brush, the powder sticking to the sides thoroughly removed. The connection to the cyclones should be removed, opening closed, and the chamber flushed with warm water (45°C), 1 percent general-purpose detergent solution and final rinsing with hot water (50° to 60°C). The atomizer disc should be first dismantled and soaked in warm 1 percent general-purpose detergent solution to soften the milk film, and then followed by vigorous hand brushing with a clean brush and rinsing with hot water.

The milk feed line should be cleaned by connecting it to the return line and circulating detergent solution from the feed tank as in the in-place cleaning system.

6. CHECK FOR PROPER CLEANING AND SANITIZATION

6.1 In dairy plants, various equipment should be subjected to regular checking of their proper cleaning and sanitization. The limits of residual micro-organisms at three levels (Satisfactory, Fairly satisfactory and Unsatisfactory) are given in Table 4 along with the corresponding methods of test and frequency of checking.

6.2 Walls, floors and milk crates should be checked for general cleanliness. They should be free from visible dirt and mould growth.

7. DAIRY FLOORS AND WALLS

7.1 Dairy Floors — The cleaning of dairy floors (cement concrete, stone or tile) is a simple process if done daily. Flooding with hot soap-and-cleaner (or wetting-agent-and-cleaner) solution, followed by scrubbing with clean, hard floor-brush, should be generally used. After giving a final hot water rinse, mop off with a rubber squeeze to ensure rapid drying.

TABLE 4 LEVELS OF PROPER CLEANING AND SANITIZATION

(*Clause* 6.1)

Sl No.	Equipment	Method	Ref to Cl No. of IS : 1479 (Part V)-1962*	Results to be Expressed as	Levels			Frequency of Checking
					Satisfactory	Fairly Satisfactory	Un-satisfactory	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Milk cans/pails	Rinse method	4.3 and 6	SPC† per litre of holding capacity	Not more than 1 000	Over 1 000 up to 5 000	Over 5 000	‡One in every batch of 50
ii)	Milk bottles	—do—	4.3 and 5	—do—	—do—	—	Over 1 000	‡Four bottles just before the addition of fresh lot of detergent
iii)	Milk receiving tanks/vats	Swab method	4.2	SPC† for 900 cm² of surface	Not more than 5 000	Over 5 000 up to 25 000	Over 25 000	Once every day immediately after the preparation of equipment for operation
iv)	Weighing bowls or pans	—do—	—do—	—do—	—do—	—do—	—do—	—do—
v)	Storage/holding/transport tanks	—do—	—do—	—do—	—do—	—do—	—do—	—do—
vi)	Batch type holding pasteurizer	—do—	—do—	—do—	—do—	—do—	—do—	—do—
vii)	Surface cooler	—do—	—do—	—do—	—do—	—do—	—do—	—do—
viii)	Plate type heat exchanger	—do—	—do—	—do—	—do—	—do—	—do—	—do—
ix)	Cotton filter cloths	—do—	—do—	—do—	—do—	—do—	—do—	Once every week
x)	Evaporators	—do—	—do—	—do—	—do—	—do—	—do—	Every time the equipment is cleaned for operation
xi)	Ice-cream freezer	—do—	—do—	—do—	—do—	—do—	—do—	—do—
xii)	Roller drier	—do—	—do—	—do—	—do—	—do—	—do—	—do—
xiii)	Bottle filling machine	*Circulation Method*: Sterile or boiled and cooled water or skim milk shall be allowed to pass through the unit and the first one litre of water or milk coming out shall be collected in sterile container and tested for SPC† and Coliform count§	—	Counts per litre of capacity	SPC† not more than 25 000 and Coliform count§ not more than 10	SPC† over 25 000 up to 100 000 Coliform count§ over 10 up to 100	SPC† over 100 000 and Coliform count§ over 100	—do—
xiv)	HTST plate pasteurizer	—do—	—	—do—	—do—	—do—	—do—	—do—
xv)	Homogenizer	—do—	—	—do—	—do—	—do—	—do—	—do—
xvi)	Cream separator/clarifier	—do—	—	—do—	—do—	—do—	—do—	—do—
xvii)	Spray drier	—do—	—	—do—	—do—	—do—	—do—	—do—

*Methods of test for dairy industry: Part V Methods of dairy plant control.

†Standard plate count [*See* 5 of IS : 1479 (Part III)-1962 'Methods of test for dairy industry: Part III Bacteriological analysis of milk'].

‡To be seleted at random.

§*See* 8 of IS : 1479 (Part III)-1962.

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7.1.1 Some areas where fat has worked into the floor surface require special attention daily. At such places, a floor cleaner mixture (consisting of sodium metasilicate 60 percent and trisodium phosphate 40 percent) should be sprinkled dry on the floor and scrubbed thoroughly with a floor brush; alternatively, a solution of a suitable wetting agent may be used. This should be followed by hot water rinse as described in **7.1.**

7.1.2 Cement concrete floors, or tiled floors fixed with cement, should not be cleaned with solutions of sulphuric acid (even waste Gerber acid). Acid removes grease by dissolving the surface layer of concrete to which the fat is adhering. The acid treatment effectively cleans the floors, but it leaves the surface in a rough and porous condition permitting rapid absorption of dirt and fat, which becomes increasingly difficult to remove. Continual use of acid for the cleaning of concrete thus destroys the surfacing and greatly shortens the wearing life of the floor.

7.2 Dairy Walls — The cleaning of dairy walls (cement concrete or tile) should be done on similar lines as for floors mentioned in **7.1.**

8. COLD STORES

8.1 Floors, Walls, and Roof

8.1.1 *Cleaning* — Clean the roof and the side walls of the cold store with a long-handled brush. Hose down the dirt and the soil on the floor and the side walls to the floor drain with tap water. Cleaning mixture consisting of sodium metasilicate (60 parts) and trisodium phosphate (40 parts) may be used at 1·5 percent concentration in tap water for cleaning the floors and walls for market milk cold store daily.

For cleaning the greasy rooms of butter and cheese cold stores 5 percent soap powder may be compounded in this cleaning mixture and used at the same rate. The walls (tiled portion) and the floors should be thoroughly cleaned with brush and squeezed before sanitization.

8.1.2 *Sanitizing* — Sanitizing is recommended by swabbing with 0·73 percent solution of 8-hydroxyquinoline tartrate or quaternary ammonium compounds (QAC), such as Acifix, Cetavlon or equivalent compounds (1 : 1 000 parts of water). For disinfection of air in the cold store, a spray of QAC (10percent) or aerosols containing resorcinol and glycerol should be used. Ozone generators, and ultra violet lamps (2 537°A) for continuous sanitization of cold stores may be used, if available. Both swabbing and air disinfection should be done daily.

8.1.3 *Fumigation* — If the facilities exist for storing dairy products in alternative cold rooms, then the cold store may be completely emptied by

transferring the stored products in the other cold rooms. After turning off the cold, carbon dioxide in the form of dry ice may be used for fumigating at the rate of 15 percent concentration of 0·5 kg/m³ for 24 hours as a rodent preventive measure.

8.1.3.1 *Frequency of fumigation* — Fumigation may be carried out at least thrice in a year at suitable intervals. Fumigation should be followed by thorough cleaning and sanitization of cold stores as mentioned in **8.1.1** before storing the products.

8.2 Shelves and Racks — Clean them with hot 1·5 percent solution comprising of sodium metasilicate (60 parts) + trisodium phosphate (40 parts) + soap powder (5 parts) and then wipe them dry. Sanitize them with 0·73 percent solution of 8-hydroxyquinoline tartrate or QAC (1 : 1 000 parts of water).

NOTE — The walls, roof and the doors should be painted with antifungal agents. Agents like cunilate, copper-8-quinolinate or similar compounds at the rate of 90 g/l are quite effective. The worn out rubber gaskets of the doors should be replaced in time.

APPENDIX A

(*Clause* 0.2)

GENERAL INFORMATION ON DETERGENTS AND SANITIZERS

A-1. CLEANING AND STERILIZATION

A-1.1 Cleaning — Cleaning of dairy equipment implies the removal of the soil from the surface of the equipment. Soil is primarily milk or milk product residues which may be more or less modified by processing treatment or by interaction with water or with cleaning materials previously used, or by dust, dirt or other foreign matter.

A-1.2 Sterilization — Sterilization or sanitization, which is more generally used in modern dairy practice, implies the destruction of all pathogenic (disease producing) and almost all non-pathogenic organisms.

A-1.3 Cleaning and sterilization are complementary processes; either of them alone will not achieve the desired end result, which is to leave surfaces as free as possible from milk residues and from viable organisms.

A-2. TYPES OF SOILS

A-2.1 In the dairy industry, the soil (**A-1.1**) that has to be removed from plant and equipment during cleaning operation may be in one, or a combination of more than one of the following forms:

a) Liquid milk films,

b) Air-dried films,

c) Heat-precipitated films.

d) Heat-hardened films,

e) Milk stone, and

f) Miscellaneous foreign matter.

Thus soil may range in composition from normal milk film to residues consisting largely of fat and protein matter frequently mixed with hard water scale of calcium and magnesium salts.

A-3. DETERGENTS AND STERILIZERS

A-3.1 Detergents — Detergents or cleaning/washing compounds are substances capable of assisting cleaning; they include soaps, alkaline materials, acids, organic surface active wetting agents, etc.

A-3.2 Sterilizers or Sanitizers — They consist of substances capable of destroying all pathogenic organisms and almost all non-pathogenic organisms adhering to the cleaned surface.

A-4. PROPERTIES OF DETERGENTS AND STERILIZERS

A-4.1 Detergents — Detergents or cleaning/washing compounds should have the following properties:

a) Wetting and penetrating power — breaking the bond between the soil and the surface to which it adheres;

b) Emulsifying power — holding unsaponifiable oils and fats in solution;

c) Saponifying power — making soaps out of the fatty acids of oils and fats;

d) Deflocculating power — holding insoluble particles in suspension;

e) Sequestering and chelating power — making water soft by tying up metallic ions in a manner to prevent precipitation;

f) Quickly and completely soluble;

g) Relatively non-corrosive to metal surfaces;

h) Free rinsing;

j) Economical;

k) Stable during storage;

m) Mild on hands if used for washing hands; and

n) Possess germicidal action, if possible.

A-4.1.1 It is obvious that no single detergent will possess all the properties mentioned in **A-4.1**, and so at present there is no single 'all-purpose' detergent. The varying types of soils encountered, the different surfaces to be cleaned and the varying water supplies available make it difficult to compound such universal materials. It is inevitable, therefore, that most dairies should use two or more detergents for their different operations if cleaning efficiency combined with safety is to be obtained.

A-4.2 Sterilizers — Dairy sterilizers/sanitizers should be:

a) non-toxic,

b) quick acting,

c) relatively non-corrosive to hands and equipment,

d) easily and quickly applied, and

e) relatively inexpensive.

A-5. TYPES OF DETERGENTS AND STERILIZERS

A-5.1 Detergents — The detergents generally used are broadly classified into the following four groups:

a) *Alkalis* — most commonly used.

b) *Acids* — increasingly used.

c) *Polyphosphates, and Chelating Chemicals* — added to alkalis/acids.

d) *Surface Active or Wetting Agents* — added to alkalis/acids or used alone.

A-5.1.1 Detergents composed principally of inorganic alkalis at suitable *p*H are generally based on one or more of the following:

	*p*H (*approx*)
a) Sodium hydroxide (caustic soda)	13·1
b) Sodium carbonate (soda ash)	8·4-11·4
c) Sodium phosphates	12·0
d) Sodium silicates	12·5

A-5.1.1.1 The following ingredients among others may be added for special purposes:

a) Sodium bi-carbonate and/or sodium sesquicarbonate, and

b) Sodium sulphite.

A-5.1.2 By careful choice from the above materials it is possible to prepare mixtures possessing the desired degrees of alkalinity, causticity, buffering power, rinsing power and ability to prevent the formation of scale from the hardness constituents of water. Thus if a high degree of caustic alkalinity is required, sodium hydroxide will form a large proportion of the mixture. If good rinsing properties are desired, then sodium metasilicate and the phosphates will feature prominently. Sodium metasilicate and silicates in general are more effective than other alkalis in reducing the adhesion between the soil and the surface. In view of its cheapness, sodium carbonate is invariably used. Because of their low alkalinity, sodium bicarbonate and/or sodium sesquicarbonate are used in preparing detergents which may come in contact with the hands. Sodium sulphite acts as a corrosion inhibitor, that is, it helps to protect tinned/aluminium surfaces from attack by alkalis.

A-5.1.3 Mild acids have been found most satisfactory for milkstone removal. Those used are phosphoric, tartaric, citric, gluconic and hydroxyacetic acids in strengths of approximate 0·1 percent. Most acid cleaners are combined with wetting agents to provide the greatest possible penetration of soils. Strong acids like nitric are also used only with stainless steel surfaces in strength not exceeding 0·1 percent.

A-5.1.4 Polyphosphates and chelating chemicals are used, in conjunction with alkalies and acids, for their ability to prevent precipitation of hardness salts from the water. This sequestering property becomes more important where hard water is used than where water is already soft or softened. Tetra-phosphate, hexa-meta-phosphate, tripoly-phosphate and pyro-phosphate are all used in commercial dairy cleaners.

A-5.1.5 Surface active or wetting agents improve the wetting of particles and penetration of the solution into minute spaces between and under soil particles and equipment surfaces. They also assist in forming stable dispersions and emulsions. Common soaps, Acinol-N, Idet-10, Teepol, or equivalent compounds, belong to this category.

A-5.1.6 The emulsifying, wetting, foaming, dispersing and overall detergent properties of a cleaning solution are to a large extent dependent on the conditions existing at the interfaces between liquid and air, liquid and oil, and liquid and metal or other solid surfaces, for example, milk deposits.

Substances which, when used in quite small concentrations, are capable of profoundly influencing the interfacial conditions or surface activity are known as surface active agents. Some of these agents may be designed essentially as wetting agents, others as emulsifying agents, dispersing agents detergents and so on. Some possess all these properties to some degree whilst others possess only one or two. It should, however, be appreciated

that these individual properties are to a large extent interrelated, particulary under the very varying conditions of use to which surface active agents are put.

An important additional characteristic of modern surface active agents is that, in general, they possess excellent chemical stability. In this respect they differ fundamentally from soap, which may be regarded as the oldest surface active agent. They are effective, for instance, under acid as well as alkaline conditions and, perhaps of still greater importance, they may be used satisfactorily in hard and saline waters. Because of this, they may be added to solutions of alkalis or acids, thereby increasing their effectiveness, or they may be used alone where conditions do not permit or require the use of acids or alkalis.

The many surface active agents now available and in use generally fall into one of the following chemical types:

i) Sodium alkyl aryl sulphonates	$RC_6H_4SO_3Na$
ii) Sodium primary alkyl sulphates	$ROSO_3Na$
iii) Sodium secondary alkyl sulphates	$R_1R_2CHOSO_3Na$
iv) Sulphated mono-glycerides, sodium salts	$RCOOCH_2CH(OH)CH_2SO_3ONa$
v) Sodium amide sulphonates	$R\ CONHC_2H_4OCH_2SO_3Na$
vi) Polyethenoxy compounds	$R\ O\ C_2H_4\ (OC_2H_4)_n\ OH$
vii) Quaternary ammonium compounds	$(R_1R_2R_3R_4)$ N. halogen

NOTE — R, R_1, etc, in the above formulae represent organic radicals. Types (i) to (v) are known as anionic agents because in aqueous solution they dissociate to give, for example, the sodium cation $(Na)^+$ and a surface active anion $(R\ O\ SO_3)^-$.

Type (vi) agents are known as non-ionic agents because in aqueous solution ionization is negligible and the whole molecule is hydrated.

Type (vii) agents are known as cationic agents because in aqueous solution they dissociate to give a halogen anion.

While cationic agents have useful detergent properties, they are at present primarily used for their bactericidal properties.

A-5.2 Sterilizers/Sanitizers

A-5.2.1 The sterilizers/sanitizers commonly used are:

a) steam,

b) hot water, and

c) chemicals.

A-5.2.2 With steam or hot water sanitizing all surfaces should be heated to at least 71°C for not less than 16 seconds. With steam, every part of the surface should be bathed in live steam. With hot water, the initial temperature should be such that at the time of leaving the equipment its temperature should be 71°C or above and this 71°C water should be in contact with all parts of the equipment for at least 5 minutes.

A-5.2.3 The chemical sanitizers used in the fluid milk plants may be chlorine compounds, iodine compounds or quaternary ammonium compounds. These are applied in solution from over the equipment surfaces. A thin continuous film over the clean surfaces is all that is needed to produce satisfactory results. Temperature is not a critical factor, for chemical solutions are effective over a wide range of temperatures. Chlorine compounds have a high sanitizing efficiency at low cost when used in proper concentration and at a suitable *p*H. Generally speaking, chlorine is used in concentrations of from 50 to 300 ppm available chlorine. Among the chlorine compounds used in the dairy plant are the following: calcium hypochlorite (bleaching powder), sodium hypochlorite, etc.

A-6. QUALITY OF WATER

A-6.1 Since water is the solvent used for carrying the detergents and efficiency of cleaning depends on the quality of water, it is desirable that the water used should preferably have no hardness or when it is not softened earlier it should be treated with chemicals to offset the effects of natural hardness. Water used in dairy plants should correspond to 0° hardness. Under village conditions, it is not possible to prescribe any limit for hardness of water but it is advisable to check the hardness periodically.

A-6.2 Hardness of water may be checked in accordance with **16** of IS : 3025-1964*.

A-7. PRINCIPLES OF THE CLEANING AND STERILIZING PROCESSES

A-7.1 Essentially all cleaning processes, such as those involved in dairy work, comprise the following stages:

a) Wetting of the soiled surface; usually it is not possible to do this effectively by water alone.

b) Removal of the soil from the surface by solution, emulsification saponification and/or mechanical action.

c) Dispersion of the undissolved soiling matter.

*Methods of sampling and test (physical and chemical) for water used in industry.

d) Removal of the used detergent solution together with the soil.

e) Removal of the last traces of detergent solution by adequate rinsing.

A-7.2 The well-cleaned surface is then sterilized/sanitized with steam, hot water or chemicals. For successful use of sanitizer, the surface to be sanitized should be absolutely free from organic matter (fat, milk film, milkstone and other such materials). Sanitizers, to be most effective, should be used just prior to use of the equipment so that surviving organisms will not have time to multiply.

A-7.3 The method of cleaning broadly consists of soaking, brushing, spraying and re-circulation or by both. Among the cleaning aids and tools are included light weight hose, shut-off valves (attached to end of the hose), different types of brushes (nylon fibre being preferred now-a-days), etc.

A-7.4 The method of chemical sanitization broadly consists of flushing, spraying and brushing, fogging and submersion.

A-8. STORAGE, MEASUREMENT AND INSTRUCTIONS ON USE

A-8.1 Storage — Detergents/sanitizers should be stored in covered containers in a dry place.

A-8.2 Measurement — Detergents/sanitizers should be carefully measured or weighed when solutions are being made up. Careless measuring of detergents may lead to unnecessary waste, ineffective cleaning or damage to plant.

A-8.3 Instructions on Use — Detailed instructions should be given to the plant operators on the use of detergents/sanitizers, and a regular check should be made to see whether these instructions are being followed.

A-9. NATURE OF SURFACE

A-9.1 Milk contact surfaces in the dairy plant should be polished or smooth. Rough surfaces are difficult to clean and deposits may adhere tenaciously and harbour bacteria. It is for this reason that the use of even finely divided soft abrasives on smooth surfaces should be restricted to an absolute minimum.

A-9.2 Materials used in dairy equipment include stainless steel, mild steel, tinned steel and tinned copper, nickel alloys, aluminium, glass, vitreuos enamal, plastics and rubber. The precautions necessary to take with these materials are given in Table 5. Organic surface active agents as normally used will not affect these materials.

TABLE 5 PRECAUTIONS WHILE USING IN USE OF DETERGENTS AND STERILIZERS/SANITIZERS FOR DIFFERENT MATERIALS USED IN DAIRY EQUIPMENT

(*Clause* A-9.2)

MATERIAL	CLEANING	SANITIZATION
(1)	(2)	(3)
Stainless steel	All alkalis may be used. Care should be taken with acid.	All sanitizers may be used.
Mild steel	All alkalis may be used. When it is necessary to use acid solutions for descaling purposes, they should be effectively inhibited against corrosive action.	—do—
Tinned steel and tinned copper	Some alkalis are liable to corrode tin coatings. The effect may be mitigated by the use of alkaline detergents of low alkalinity, based on silicates, phosphates and carbonates with sodium sulphite. It is desirable that the detergent solution should contain at least 0·25 percent of sodium sulphite.	—do—
Bronze or gunmetal	Some alkalis may attack these metals. Detergents based on silicates, phosphates and carbonates are more suitable.	—do—
Galvanized metal	Some alkalis will attack zinc.	—do—
Nickel alloys	All alkalis may be used.	—do—
Aluminium	Some alkalis will attack aluminium. Detergents of low alkalinity incorporating sodium silicate or other inhibitor are essential.	—do—
Glass	Alkalis may be used. Strength of detergent depends on method of operation.	—do—
Vitreous enamel	Strong caustic alkalis attack vitreous enamel. Detergents of low alkalinity and high silicate content are suitable.	—do—
Plastics	Care should be taken to ensure that cleaning temperatures are not above the softening point of the material. Advice of the plastics manufacturer should be sought.	Only chemical sanitizers should be used.

(*Continued*)

TABLE 5 PRECAUTIONS WHILE USING IN USE OF DETERGENTS AND STERILIZERS/SANITIZERS FOR DIFFERENT MATERIALS USED IN DAIRY EQUIPMENT — *Contd*

MATERIAL	CLEANING	SANITIZATION
(1)	(2)	(3)
Rubber (natural and synthetic)	When rubber has been in contact with fatty materials, strong alkalis should be used to remove this fat.	Only chemical sanitizers should be used.

NOTE 1 — In the case of metal or other surface coatings, the advice of the equipment or detergents/sanitizer manufacturer should be sought.

NOTE 2 — Chlorine sanitizers have a tendency to cause corrosion when left in contact with all dairy metals. This tendency towards corrosion may be overcome by using the chlorine sanitizing solution just before processing so that the chlorine will be in contact with the metals for a minimum period of time before being neutralized by the product. Chlorine solutions function most efficiently at a *p*H of 8 to 9. Ranges above this *p*H value result in slower germicidal action and lower corrosion rates. Values below *p*H 8 provide very rapid germicidal action, but corrosion rates are excessive.

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